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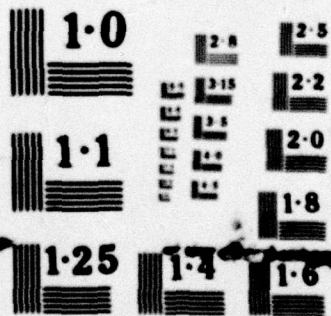UNCLASSIFIED    NPS52-79-002                                              NL

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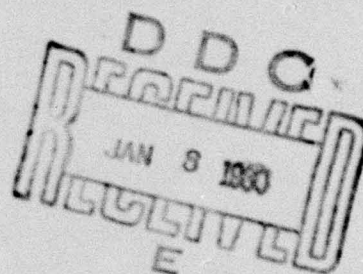# LEVEL

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for

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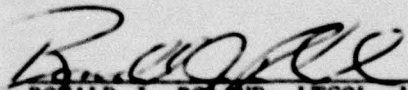
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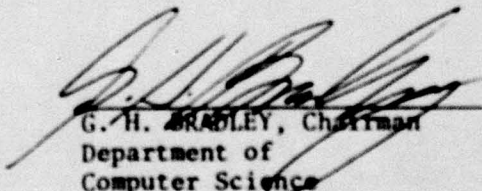Superintendent

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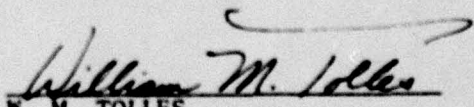Provost

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| DSS | AI | modules |
| MIS | production systems | |
| management information systems | production rules | |
| contingency matrix | technology transfer | |

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Technology transfer is the process by which technology originating at one institutional setting is adapted for use in another. A major impediment to the implementation of new technologies to assist with managerial decision making problems is a lack of communication between the technology and management communities. Development of a tool designed to bridge the technology transfer gap is the goal of this research. The result will be a prototype software package which may be used on an interactive computer terminal by a manager

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for assistance in designing a decision support system (DSS).

There are four primary research tasks. These are:

1. Develop a conceptual model of the DSS design process.

2. Select and adapt, or create, appropriate software to mechanize the model.

3. Develop a knowledge base to describe the interactiveness of various organization variables and managerial decision making needs.

4. Collect and analyze interview data and implement resultant production rules on the model.

Tasks one (1) and two (2) have been accomplished and establish the feasibility of this effort. The interview instrument has been developed for task three (3), and representative firms selected for interviews. A prototype production rule model (called DECAIDS for decision aids) which supports managerial decision making was constructed using Stanford University's EMYCIN production rule system. DECAIDS demonstrates the use of production rules to support a relatively unstructured management problem.

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# A DECISION SUPPORT SYSTEM MODEL

## for

## TECHNOLOGY TRANSFER

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ABSTRACT

## A Decision Support System Model
## for
## Technology Transfer

Technology transfer is the process by which technology originating
at one institutional setting is adapted for use in another. A major
impediment to the implementation of new technologies to assist with
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the technology and management communities. Development of a tool
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prototype production rule model (called DECAIDS for decision aids) which
supports managerial decision making was constructed using Stanford
University's EMYCIN production rule system. DECAIDS demonstrates the use
of production rules to support a relatively unstructured management problem.

## I. INTRODUCTION

### MIS Growth

"Spectacular growth in the use of computer-based information systems and quantitative approaches to managerial decision-making has created a need for both managers who can properly use sophisticated decision-aiding systems and for research towards understanding and designing such systems." (Kenreuther, 1978).

The application and use of automatic data processing (ADP) has become a standard, vital element for the efficient operation of most large, and many not-so-large organizations. Although the decision makers at the mid-and-top-management levels could equally benefit from the capabilities of ADP, the extent to which it has been applied beyond the operational management levels (accounting routines, operations control, production line robots, automatic guidance systems, record keeping, etc.,) is minimal.

For example, the ADP support for the Department of Defense's World Wide Military Command and Control (WWMCC) System consists of a multi-million dollar computer network which provides a high degree of administrative reporting. Another multi-million dollar system is the Navy's Tactical Data System (NTDS), an automated, near real-time combat direction system for clearly defined combat operational roles. These systems reflect the typical use of computerized technology in public applications and are not atypical for the private sector, i.e., massive support for the transaction processing and operational control functions.

### Decision Aids

There have been many efforts to describe how a MIS can be built to satisfy (in part) middle and top-level decision making requirements (Keen, 1978; Davis, 1974; Lucas, 1978, Burch and Strator, 1974).

Advanced ADP techniques which could be used in direct support of higher management needs are in the field known as operational decision aids (ODA) or decision support systems (DSS). A decision aid is considered a human-system interface designed for the specific purpose of supporting and enhancing the manager's or commander's decision making ability (Keen, 1978;58-9). It is a tool which can be used by the decision maker to assist in or enhance effective decision making. Although a pen or pencil may be included in this definition the use herein will mean mechanical or electrical (usually computer assisted) devices. Decision aids are generally, but not necessarily, supported by a MIS.

The term operational decision aid is defined within a specific, on-going, research program started in 1973 by the Navy's Office of Naval Research (ONR) to address issues having to do with decisions made by relatively senior officers and their staffs, e.g. task force commanders. The program is aimed at automating certain elements of naval command and control systems. The major components of the ODA program are computer science, decision analysis, systems analysis and organizational psychology (Sinaiko, 1977).

Conversely, decision support system (DSS) is a title used extensively in the open literature. The DSS is computer based support for management decision makers who are dealing with semi-structured problems. The system is usually a collection of levels of support ranging from access of facts to the use of filters and pattern-recognition for information retrieval, simple computations, comparison, projections, etc. DSSs include various models useful to managers (Keen and Scott Morton, 1978;97).

DSS technologies have not proliferated for a variety of reasons, two of which are noteworthy. One is the inability to effect adequate transfer of technology from the research/academic areas to the manager.

The other, and perhaps more important reason, is the lack of a model to
describe decision support tools based on given organization variables
such as organization structure, managerial style, environment circumstances,
organizational needs, and technology.

## Technology Transfer

Technology transfer is "the process whereby technical information
originating in one institutional setting is adapted for use in another
institutional setting," (Doctors, 1969). This transfer is a complex
mechanism that involves the coordination of many facets of the techno-
socio-politico-economic system. "Technology transfer of any significance
will only occur when the right people, the right markets, and the right
ideas coincide with usable technology at the right point in time,"
(Kimball, 1967). A major problem for many of today's organizations is
the lack of knowledge concerning available technologies that could be
applied toward increasing company profits and growth. No management
tool currently exists that can be used to effect the transfer of
technology from the research environment into managerial application.

Computer science, management science, and communications technologies
are now capable of providing decision aiding tools to higher management,
but the problems of educating these users in current capabilities and of
describing a model to meet specific decision-maker requirements have not
been solved. "Many important elements of the manager's planning functions
are still not well supported by computerized information systems," (Cleland
and King, 1975;146). Education of the technologists has similarly been
ignored with respect to their learning the user requirements, needs and
capabilities (or lack thereof).

A possible solution to both of these problems is the development
and implementation of a model which would describe relevant organization

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characteristics in a manager's language, and prescribe characteristics
of appropriate decision aiding systems in simple technological terms.
A graphical model, or decision table representation, might support such
an effort if the number of variables and capabilities were small,
however, modeling even a minor part of a manager's decision making
situation quickly becomes a very complex task. If current technological
capabilities of DSSs are added to the model it is evident that an automated
manipulation and analysis capability is needed.

## Purpose of Research

The purpose of this research is to develop a prototype computer model
which may be used to effect technology transfer. The model will prescribe
DSS capabilities based on organizational variables such as available
technology, managerial style, environment of the user, timeliness, and
task requirements of the decision environment, all of which affect the
decision making situation. The model will be designed for managers to use
in identifying decision aid capabilities in support of their medium and
long range decision making requirements. Concurrently this same model may
be used by DSS researchers to identify managers' needs in order to better
direct research efforts.

Developed as a prototype, this computer model is presented as a
methodology of describing and studying the complex interactions of six
organizational variables. Resultant prescriptions presented by this
model will consist of a grouping of characteristics or capabilities which
should be considered for inclusion in future DSSs planned in support of
the described organizational setting. As the organization changes or new
DSS capabilities are introduced the model can be updated.

Conversely, given a specific DSS the model will describe an appropriate
organizational setting to maximize the effectiveness of using that DSS.

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## Context of the Research

The context of the research includes several related disciplines.
The major, abstract concepts include decision support systems (DSSs),
decision analysis, contingency matrix, and production systems. DSSs,
previously described, are tools or applications designed and implemented
to support specific managerial circumstances.

Decision analysis is a quantitative methodology which permits the
systematic evaluation of the costs or benefits accruing from a course of
action that might be taken in a decision situation. It includes identifi-
cation of alternative choices involved, the assignment of values for
outcomes and an expression of probability of these outcomes being realized
(Barclay et al, 1977;vi). Decision analysis techniques such as multi-
attribute theory, prioritization schemes, and decision structuring, for
example, have been used as a basis to build many DSSs.

The contingency matrix is used to identify and develop functional
relationships among organizational variables. An organization can be
defined as a social system consisting of resource subsystems, or energy
variables, in an environmental suprasystem working to achieve a set of
objectives. Subsequently, contingent relationships are identified and
placed appropriately in a matrix fashion (Katz and Kahn, 1966: Thompson,
1967: Churchman, 1968: Shetty and Carlisle, 1972;38-45: Lorsch and Morse,
1974: Kast and Rosenzweig, 1974). Inclusion of decision support system
capabilities completes the matrix of the proposed model.

Production systems[1] originated from early work in symbolic logic

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[1] Riggs (1970;5) described typical production systems as consisting
of an input, a conversion process, and an output. As used in this
research the input are data, the interpretation of the data is the
conversion process, and knowledge is the output or product. More
specifically these production systems used in artificial intelligence
applications are sets of rules which form premise-conclusion or
situation-action pairs and are combined in such a way as to produce
information (Winston, 1977;144).

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(Post, 1943). A production system is a collection of rules of the form CONDITIONS → ACTIONS, (Newell and Simon, 1972; Waterman, 1976; Waterman and Hayes-Roth, 1978), where CONDITIONS are statements about the contents of a data base and the ACTIONS are procedures that may alter the contents of the data base. The system is given a condition to make true, a premise to prove, or, in effect, a question to answer through deductive inference.

Many conceptual organization models and DSSs schemes have been developed. Operationalizing these concepts and models has not been accomplished due to the lack of an adequate tool or device to manipulate such complexity.

### Summary

To summarize, this study provides a review of research efforts to build and operationalize decision support systems, i.e., DSSs designed to assist managers at various organization levels with their decision making requirements. It categorizes elements of various decision aids and correlates these capabilities with specific organizational variables in order to examine the context in which DSSs operate. A conceptual six-variable organization framework is proposed where the interrelationships among characteristics of the six variables, and general capabilities of decision aiding systems, are described by a series of IF...THEN production rules. Finally, data are collected and a computer model based on artificial intelligence heuristics (production systems) is created to examine the consequences of various organization - DSS interactions.

## II. BACKGROUND
### Decision Science

Research in decision science models includes and attempts to integrate

a diverse collection of related fields: organizational behavior and theory relating to the structure of organizations and the human leadership role; traditional management science focusing on planning, scheduling, and inventory; the study of information systems, particularly data base management, decision support systems, and office automation; and the psychology of decision processes, with a focus on risk and uncertainty. Marked by this diversity, this research has a unifying theme: understanding and improving decision-making support. The various disciplines underlying the decision sciences contribute to this objective, not only separately, but synergistically:

. research in decision processes provides new knowledge about how to adapt problem-solving methods to the needs of the decision-maker.

. research in management information systems (MIS) investigates how best to provide information for organization decision-making.

. research in operations research/management science (OR/MS) studies formal models and methods for structuring and solving certain classes of managerial problems.

. research in social science, especially the behavioral areas, provides insight into the results of human interactions.

. research in decision support systems (DSSs) carries the promise of integrating these areas through interactive computer-based models.

Thus research in the decision sciences intends to provide a synthesis of the human, the machine, and manipulative designs for decision assisting systems.

Decision Support System

The design of an operational model that incorporates ingredients vital

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to the survival of an organization and can prescribe useful decision assisting tools will not only contribute to organizational health but provide an extension of MIS theory.  Combining the research of the decision sciences will provide additional bases to support the ramifications and concept of contingency theory (Luthans, 1976).

Decision support systems, in the context of this study, imply the use of computers to assist managerial decision making in semistructured tasks. The DSS is intended to emphasize support rather than replacement of the manager's judgement with an overall goal to improve the effectiveness (vice efficiency) of decision making.  DSSs are considered different from MISs or OR/MS tools in that the DSSs:

. are developed primarily for use by managers and

under the manager's control,

. impact on not-well-structured decision areas, and

. extend management's capacity to formulate answers

to "what if" questions.

Research in DSSs has been concerned with creating a meaningful dialogue between designers and users of interactive computer-based systems.  The development and use of "expert systems" to support DSS designs may be the first step toward integrating the technologist, researcher and user (Feigenbaum, 1978).   An expert system can be described as a computerized system that relies on the incorporation of a large amount of human knowledge in a data base which can then be interrogated to provide suggested actions or decisions.  These systems often use techniques of artificial intelligence such as production rules, to provide choice options to the decision maker.

The expert system may be illustrated by looking at the MYCIN program developed at Stanford University (Shortliffe, 1976).  MYCIN is an interactive, question-answering computer system which involves the user in identifying

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specific infections in humans. It then provides suggested diagnoses and treatment. MYCIN integrates the ability to answer the question "Why?" during and after each exercise. It will also store and retrieve cases for future reference. MYCIN incorporates the concepts of decision analysis within the framework of artificial intelligence (AI) production rules. Expert opinion was, and is, provided by medical doctors who specialize in the field of microbiology.

The Portfolio Management System (PMS) like MYCIN, was designed and implemented with specific user requirements defined, (Keen, 1978; 101). The PMS is a computer graphics-based system with a variety of fairly simple models operating from a large, complex data base. It is designed primarily to be used by investment managers of large banks. While PMS is considered a DSS, as is MYCIN, their structures are totally different yet the results are very similar, i.e. direct support for the decision making function.

Williams (1978) provides generic descriptions of other similar but different decision aiding technologies. In one case decision structuring was used to aid decision making with respect to movement of a large naval force to evacuate personnel (civilian and military) from Lebanon. Another DSS, based on prioritization schemes, was used to prepare budget submissions to Congressional committees. These examples illustrate how organizational management was provided an extended capability, through the availability and use of an automated DSS, to manage resources under continued conditions of uncertainty and tension.

There are several other examples of the design and application of similar systems (see Hart, 1978; Little, 1975: Meador, 1974; and Kruzic, 1978). The distinguishing points about each of these circumstances are that:

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1. the user (manager) is, or was, operating under pressure in a complex task.

2. the DSSs incorporate a detailed methodology by defining and assessing the process of managerial decision making.

3. the decision processes are multi-dimensional, multi-objective, and only a part of the task can be automated. Computer support is used to manipulate data and display information.

4. the DSS technology provides managers with access to computer power, gives fast response, and is easy to use.

5. computer support, carefully matched to the decision problem, the decision makers ability, and the decision context, substantially helped the manager.

## Controversy

A certain amount of theoretical controversy surrounds the subject of this study. Early MIS efforts were highly criticised for advertising a capability beyond anything that could be delivered (Deardon, 1972;90-99). Clearly, Deardon had identified many weaknesses, e.g., the "total" systems approach, centralization arguments, homogenity of management information, etc., in the optimism of some technologists. Deardon's thinking persists in many areas and supports the resistance to change in trying to introduce DSS technologies or even learn about them.

The expanding role of computer applications and concurrent reduction in the cost of hardware since 1972 has greatly broadened the views of both the technologists and user communities. Coupled with changing environments, better educated users, tight economies, and ever narrower profit margins, increasing the effectiveness of decision making is a high value item.

Technology alone, however, is not enough because the dynamics of today's organizations do not permit such independence. Theoretical issues

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or organizational phenomenon influence the construction and use of various aids (Nolan, 1975). Unless relevant organizational attributes can be identified and their interactiveness described in some way very few executive level decision aiding system will evolve.

## III. PROPOSITIONS

The major proposition of this study is that the capabilities of effective decision support systems can be predicted by describing the organizational framework within which the DSSs exist or are planned. Conversely, characteristics of organizational variables can be described in a manner that will enhance the success of specific DSS designs. In order to support these propositions it is necessary to identify capabilities which describe decision support systems and select specific organization related variables which, taken as a whole, are representative of an organization-decision support system framework. Once identified these capabilities and variables can be so arranged as to suggest success or failure of proposed DSS-organization combinations.

Modrick (1976) provided an illustration of efforts to integrate decision aiding systems into military tactical decision making. His research results indicate the need for "adaptive decision aiding systems" engineered to fit specific decision making situations. Additional support to suggest how organizational variables directly affect DSS requirements is provided by Spector, Hayes, and Crain (1976). Their investigation of the impact of computer-based decision aids on a high level management staff resulted in identification of several significant relationships. In one instance (IBID, pp. 3-22) it was noted that the direction of communications within the Staff were dependent on the informal (leader centered) staff structure. In this instance as the organization structure became less, centralized communications became less predominantly downward to more

laterally directed. The DSS capabilities included in automatic message
handling and distribution could be used to support this structure as
the continuum of communication requirements moves from basically downward
to lateral. Simon (1965;104) summarizes this perspective:

"Organizational form . . . . must be a joint function of the

characteristics of humans and their tools and the nature

of the task environment. When one or the other of these

changes significantly, we may expect concurrent modifications

to be required in the organizational structure -- for example,

in the amount of centralization or decentralization which

is desirable."

A model depicting organizational situations can be useful for
understanding decision support system capabilities appropriate to
assist the organizational decision maker. Complexity of the initial
model can be reduced by considering a limited number of variables and
determining their interaction. Once these interactions are understood
additional variables and their interactions can be introduced and studied.
This proposal emphasizes the initial implementation of the variables group,
environment, task, structure, individual and environment.

A minor proposition is that operationalizing initial interactions
of the DSS and original variable characteristics would be possible, albeit
time consuming, by manual means. As the knowledge base is enriched with
additional characteristics and interactions, however, a computer model
will be required to effectively evaluate the data. The use of an inter-
active computer model used by a manager to facilitate user interaction
(retrieval and update) is appropriate and desirable.

This study provides the basis for identifying capabilities to design
and build automated decision aids in support of specific managerial

requirements. The thrust of this study, operationalizing a prototype
computer model to enhance effective DSS design and implementation, also
provides insight for future research. Finally, intra-organization
attributes, their interactions and descriptions, both general and specific,
and what constitutes the field of DSS is documented.

## IV. HYPOTHESES

### Introduction

It is generally hypothesized that by changing the characteristics of
selected organizational variables while holding others constant, relevant
DSS capabilities will be identified. Conversely, it is hypothesized that
a change in a corporation's DSS capabilities may suggest a change in one or
more of the organizational variables. Hypotheses have not been developed
as to what extent the relationship between the predictor (independent
variable) and the outcome (dependent variable) will be influenced by other
factors (the intervening variables).

In a more formalized sense the hypotheses may be stated as:

1. If appropriate organization variables are identified
   and manipulated, one result will be to suggest
   corresponding changes in that organization's decision
   support system(s).

2. If the decision support system capabilities change then
   corresponding organization changes may be suggested in
   order to effectively utilize the DSS in question or
   under investigation.

There are at least two findings expected from this research. First,
it is expected that there will be a positive correspondence between the
rigidity of the organizational structure and the location of DSSs within

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the organization.  Secondly, it is expected that under many circumstances relatively simple DSSs will be highly effective and satisfy many complex organizational decision support situations.  Other relationships are provided below to exemplify the hypotheses that may be explored by identifying the interactions of organization-decision support system combinations.

1. If the organizational task is composed of well structured problems then there will be minimal need for a DSS. Conversely, if the task involves a high degree of ill structured problems several DSSs may be identified.

2. If the individual (leader) is not skilled in technical analysis then DSS support will be delegated further down in the organization than otherwise.

3. If the individual (leader) is knowledgeable in technical and decision analysis methods then a higher degree of DSS support will be identified than otherwise.

4. If the organization structure is either pyramidal or divisional in nature then analytic decision aids are appropriate.

5. If the structure is pyramidal then real-time decision aids will be most appropriate.

6. If large screen displays are identified then the structure is most likely pyramidal.

## V.  MODEL DEVELOPMENT

### Contingency Matrix

The contingency matrix concept described by Luthans and Stewart (1976) can be used as a structure to initially describe the interactions of organizational variables.  The matrix will function as a means of

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driving the form of the model developed in this study and will in itself
be a first step in assisting decision-makers and technologists in the
task of defining and designing future DSSs in some coordinated manner.

The characteristics of the organization variables; Group, Environment,
Task, Structure, Individual and Technology (which I refer to as the GETSIT
variables), and their inter-relationships and intra-relationship with DSS
capabilities will comprise the matrix.  These GETSIT variables were
selected to describe the general organization, and no claim is made that
this is the only possible way to describe an organization, nor is it
ncecessarily the best way.  It is suggested, however, that the GETSIT
framework is rich enough to provide a useful and relatively complete
model.  A result of this study may be the determination that fewer variables
will be adequate.

Specific DSSs will not be included in the model, only general capabili-
ties, of which the following is a partial list for example purposes.

   large scale computer support

   regular reporting

   time-sharing

   real time capability

   batch processing

   single data base

   centralized data

   single or multiple languages, and

   display groups

      .
      .
      .

PERFORMANCE
VARIABLES

$C_k$

$M_j$

MANAGEMENT
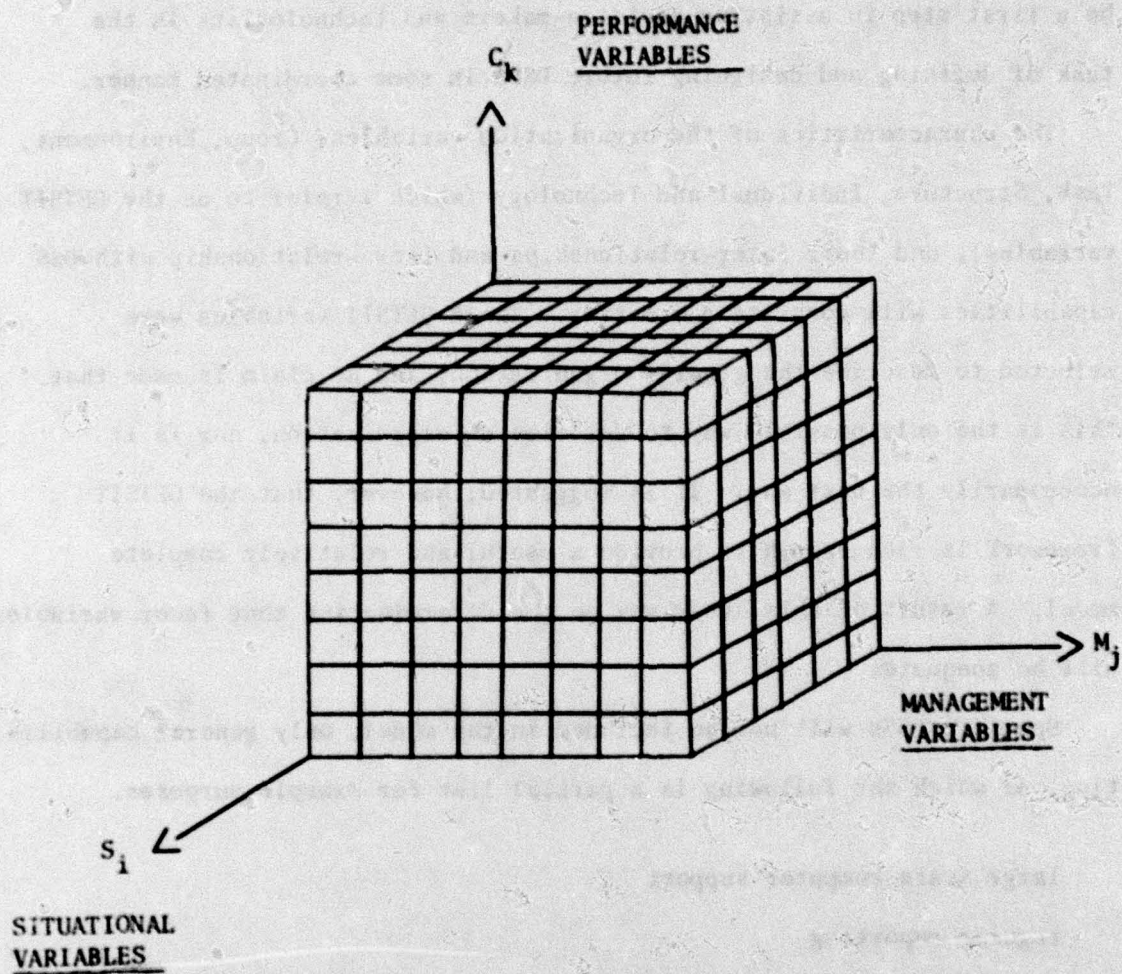VARIABLES

$S_i$

SITUATIONAL
VARIABLES

Figure 1

A GENERAL CONTINGENCY MATRIX FOR MANAGEMENT

Luthans and Stewart, 1978

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## GETSIT-DSS Relationships

Figure 2 illustrates a continuum perspective of how the GETSIT-DSS relationships might be conceptualized. The six horizontal lines represent

- - - - - - - - - - - - - - - - - - -

Figure 2 goes about here.

- - - - - - - - - - - - - - - - - - -

continuums of organization variables ranging between limits of specific variable characteristics. The outer left and right columns illustrate possible decision aid capabilities that would support the organization variable along the continuum. Certainty factors, assigned probability functions, are used to quantify the certainty of given organization-DSS characteristics being appropriate depending on the position along the six continuums a manager's perceived position is located. The interaction even at this simple level is complex when the number of possible combinations is considered.

Figure 3 represents some suggested characteristics and then only a very small number of them. Taking the variable STRUCTURE from Figure 2

- - - - - - - - - - - - - - - - - - -

Figure 3 goes about here.

- - - - - - - - - - - - - - - - - - -

to illustrate system complexity, a two dimensional contingency matrix is presented as Figure 3. While still incomplete, the magnitude of possible interactions is apparent. Expansion of this matrix to include the other five variables and all their interactions becomes a practical impossibility to manipulate by manual methods.

As these interactions begin to take some form then the production system (rule) methodology must be used instead of the contingency matrix to mechanize the model.

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<u>GETSIT-DSS Continuum</u>

### ORGANIZATION VARIABLES

<u>DSS</u>

<u>DSS</u>

. Large Scale Computer

. Regular reporting

. Little need for real-time

. No time-share

. Batch orientation

. closed ADP org.

. Single large DB

. Centralized

. single language

.

.

.

STRONG
LARGE
_____

STABLE        GROUP
OLD

STABLE
PREDICTABLE
_____
              ENVIRONMENT

WELL DEFINED
PROGRAMMABLE
_____

SIMPLE        TASK
REPETITIVE

LINE
_____
              STRUCTURE

DICTATOR
AUTHORITARIAN
_____
              INDIVIDUAL
INDIVIDUALISTIC
LONER

LOW
_____
              TECHNOLOGY
SINGLE TECH
i.e. 360/67

NEW
WEAK
SMALL

CHANGING
UNSTABLE

UNSTABLE
DYNAMIC
CHANGING
UNSTRUCTURED

ILL DEFINED
VARYING

MATRIX
PROJECT

DEMOCRATIC
WEAK

HIGH
MULT. TECHNIQUES
FRONT LINE

. multiple types of displays

. Individual or personal terminals

. Multiple sensor data coll. systems

. "What if" ques's

. Mult. data bases

. Decentralized

.

.

.

.

Figure 2

18

GETSIT-DSS

CONTINGENCY MATRIX
FOR
STRUCTURE

| ORG. VARIABLE | VARIABLE CHARACTERISTIC | DSS CHARACTERISTICS | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | REAL TIME | TIME SHARE | AUTO MSG | GRAPHICS DISPLAY | ALPHA DISPLAY | AUDIO ALARM | LARGE SCALE DISPLAY |
| GROUP | FORMAL: | | | | | | | X |
| STRUCTURE | FORMAL: | | | | | | | |
| | LINE | | | | | | | |
| | STAFF | | | | X | X | X | X |
| | FUNCTIONAL | | | | | | | |
| | MATRIX | | | X | | | | |
| | UNK | | | | | | | |
| | INFORMAL: | | | | | | | |
| | CENTRALIZED | | | | | | | |
| | CONSULTATIVE | | X | | | | | |
| | TRANSACTIONAL | | | | | | | |
| | DELEGATED | | | | | | | |
| | DECENTRALIZED | | | | | | | |
| | UNK | | | | | | | |
| TECHNOLOGY | HIGH | | | | | | | |

Figure 3

19

Figure 4 illustrates the means to structure the characteristics of
organizational variables into production rules.  These rules then define

PRODUCTION RULE EXAMPLE

IF Environment is dynamic, and

Task is low cost, and

Task is high priority, and

Structure is consultative

THEN Suggested DSS capabilities include

Individual displays,

Automated message handling,

Real time support, and

Consulting service is recommended.

Figure 4

a subset of DSS capabilities which would satisfy the originally described
interactions.  Each of the 6 GETSIT variables will be assigned character-
istics derived from the research.  Character sets may or may not be
independent.  In addition, the characteristics themselves may be modified
by the model user at any time.  A specific example of this is visualized
is provided in Figure 5.

- - - - - - - - - - - - - - - - - - -

Figure 5 goes about here.

- - - - - - - - - - - - - - - - - - -

## PRODUCTION SYSTEM MODEL

| VARIABLE | GENERAL CHARACTERISTICS | SPECIFIC |
|---|---|---|
| | | (EXAMPLES) |
| Group | $G_j, \; j = 1 \text{ to } g$ | $G_1$ = Formal |
| Environment | $E_j \quad j = 1 \text{ to } e$ | $E_1$ = Turbulant |
| Task | $TA_j \quad j = 1 \text{ to } ta$ | $TA_1$ = Semi-structured |
| Structure | $S_j, \; j = 1 \text{ to } s$ | $S_1$ = Centralized |
| Individual | $I_j, \; j = 1 \text{ to } i$ | $I_1$ = Skilled |
| Technology | $TE_j, j = 1 \text{ to } te$ | $TE_1$ = High |
| DSS | $DSS_j, j = 1 \text{ to } n$ | $DSS_1$ = Real-Time |
| | | $DSS_2$ = Time share |
| | | $DSS_3$ = Graphics display |
| | | $DSS_4$ = Not needed |
| | | $DSS_5$ = Tutorial |
| | | $DSS_6$ = Individual display |

Possible Production Rules:

1. IF $G_2$, $G_3$, $TA_{12}$, $S_1$, $I_{22}$ AND $TE_9$

   THEN $DSS_2$, $DSS_6$, $DSS_{219}$ AND $DSS_{300}$.

2. IF $E_2$, $TA_3$ AND $S_4$

   THEN $DSS_1$ AND $DSS_{100}$.

3. IF $DSS_1$, $DSS_2$, $DSS_3$, $DSS_4$ AND $DSS_{31}$

   THEN $G_3$, $E_4$, $TA_5$, $S_6$ AND $TE_{93}$.

Figure 5

## Summary

The concept of the contingency matrix is adequate to discuss the GETSIT-DSS model, however, the complexity of organization-DSS variable relationships is such that automated support is needed to implement a model that will reflect real-world interactions. An initial framework of six organization variables is described. A production system, based on concepts of artificial intelligence, is proposed as a means of modeling the complex relationships among these variables and their associated DSSs.

A prototype hardware-software system has been designed and implemented. The decision aids system, DECAIDS (Buscemi and Masica, 1979) provides alternative DSS capabilities based on user-described GETSIT characteristics. DECAIDS was constructed using Stanford University's EMYCIN production rule system and ARPANET resources at the University of Southern California's Information Sciences Institute. It (DECAIDS) demonstrates, in an on-line interactive mode, the use of an AI production rule system in support of a relatively unstructured management problem.

Access to this system for demonstration purposes may be arranged by contacting the author. A later paper will describe specific findings of the research, implementation details of DECAIDS, and knowledge base contents.

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